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Abstract

Connective tissue, from the outside of three major chuck muscles, was evaluated for binding properties when incorporated either raw or following preheating into precooked, restructured beef. Food-grade gelatin was also evaluated as a binding agent. Adding 10% raw or preheated connective tissue increased ($P<.05$) instrumentally measured tensile strength and reduced ($P<.05$) juiciness perception. One percent gelatin reduced ($P<.05$) cook yields and increased ($P<.05$) tensile strength but not to the degree of 10% raw or preheated connective tissue. Preheating had minimal effects on improving connective tissue utility. Based on the improvement in bind and cook yields, use of connective tissue as a binder is feasible in manufacturing low-salt, precooked, restructured beef.

Keywords

Cattlemen's Day, 1991; Kansas Agricultural Experiment Station contribution; no. 91-355-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 623; Beef; Restructured beef; Connective tissue; Gelatin; Tensile strength

BINDING AGENTS FOR LOW-SALT, LOW-FAT, RESTRUCTURED BEEF ROASTS: CONNECTIVE TISSUE OR GELATIN

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Summary

Connective tissue, from the outside of three major chuck muscles, was evaluated for binding properties when incorporated either raw or following preheating into precooked, restructured beef. Food-grade gelatin was also evaluated as a binding agent. Adding 10% raw or preheated connective tissue increased ($P < .05$) instrumentally measured tensile strength and reduced ($P < .05$) juiciness perception. One percent gelatin reduced ($P < .05$) cook yields and increased ($P < .05$) tensile strength but not to the degree of 10% raw or preheated connective tissue. Preheating had minimal effects on improving connective tissue utility. Based on the improvement in bind and cook yields, use of connective tissue as a binder is feasible in manufacturing low-salt, precooked, restructured beef.

(Key Words: Restructured beef, Connective tissue, Gelatin, Tensile strength.)

Introduction

Connective tissue can decrease the desirability of restructured meat texture. However, during cooking, connective tissue collagen is converted to gelatin that may contribute to bind in meat cold-cuts because it will gel when chilled. Consequently, this study was conducted to determine if adding either food-grade gelatin or connective tissue trim pulverized in liquid nitrogen could increase bind in low-salt, restructured beef.

Experimental Procedures

Three major muscles from A-maturity beef carcasses were trimmed of fat and outside connective tissue, ground through a kidney plate, mixed with .51% tetrasodium pyrophosphate (TSPP) and stored at 39 °F for 12 hr. The connective tissue trim was pulverized in liquid nitrogen. A portion was used raw and another portion was heated to 143 °F. At the end of a 12 hr preblending period, products were formulated to contain 0.2% NaCl and 0.5% TSPP and either no binding agent (control), 0.5% or 1.0% gelatin, 5.0% or 10.0% raw connective tissue, or 5.0% or 10.0% preheated connective tissue. Products were stuffed into fibrous, prestuck casings and cooked to 146°F. Proximate composition and soluble, residual, total, and percent soluble collagen were determined for raw and cooked product. Instron hardness, cohesiveness, and tensile strength were measured. Sensory panel scores for tensile strength (0 = very easy to pull apart to 10 = very difficult to pull apart), firmness (0 = not firm to 10 = very firm), initial cohesiveness (0 = clean break to 10 = high deformation), cohesiveness of mass (0 = low cohesiveness to 10 = high cohesiveness), beefiness (0 = none to 10 = intense), and juiciness (0 = not juicy to 10 = very juicy) were assessed as well. Data were analyzed as a randomized complete-block design and means were separated using least-square procedures.

Results and Discussion

No differences ($P > .05$) in proximate composition were detected. Moisture ranged from 71 to 72%, fat from 4.0 to 5.0%, protein from 22 to 23%, and ash from .95 to 1.4%. Neither total or soluble collagen contents differed ($P > .05$) for cooked products with 1.0% gelatin, 10% raw connective tissue, or 10% preheated connective tissue (Table 1). Soluble and total collagen contents of the control were .80 and 4.73 mg/g, respectively, and were less ($P < .05$) than those for all other treatments. Products with 10% raw and preheated connective tissue contained 5.98 and 5.55 mg of residual collagen per gm compared to 3.93 mg/g for the control ($P < .05$). Residual collagen contents of other treatments were similar ($P > .05$) to the control. Compared to the control, Instron hardness was greater ($P < .05$) for products with 10% raw connective tissue. All binder treatments except 0.5% gelatin increased ($P < .05$) Instron tensile strength over the control (Table 2). Although products with 1.0% gelatin or 10% raw or preheated connective tissue had significantly more soluble collagen than the control, the dramatic increase in tensile strength appeared to be more strongly related to residual collagen content. Adding 10% raw or preheated connective tissue reduced ($P < .05$) juiciness scores and tended ($P < .09$) to reduce beefiness scores compared to the control (Table 3). Adding 10% raw connective tissue increased ($P < .05$) cook yields to 90.7% compared to 90.0% for the control, whereas 1.0% gelatin reduced cook yields to 88.1% (Table 2).

This study demonstrates that connective tissue can be removed, altered, and reincorporated with beneficial effects on bind and cook yields of low-salt, precooked, restructured beef. Even though 10% addition of raw or preheated connective tissue tended to reduce product juiciness and beefiness, it dramatically increased tensile strength. That may prove significant in precooked products with salt levels too low for optimal use of meat proteins and may expand the use of low cost, high connective tissue, raw materials.

Table 1. Residual, Soluble, Total, and Percent Soluble Collagen of Precooked Restructured Beef as Affected by Gelatin (G) and Raw (CT) and Preheated (PHCT) Connective Tissue[a]

Treatment	Residual (mg/g)	Soluble (mg/g)	Total (mg/g)	Soluble (%)
Control	3.93[a]	.80[a]	4.73[a]	17.37[a]
.5 G	3.95[a]	2.89[b]	6.84[b]	40.97[bcd]
1.0 G	4.36[a]	4.78[c]	9.14[c]	51.57[d]
5 CT	4.72[ab]	2.14[b]	6.86[b]	30.46[b]
10 CT	5.98[c]	4.23[c]	10.22[c]	41.25[cd]
5 PHCT	4.21[a]	2.95[b]	7.16[b]	40.65[bc]
10 PHCT	5.55[bc]	4.60[c]	10.15[c]	45.38[cd]

[abcd]Columns ($P < .05$).

Table 2. Instron Hardness (H), Cohesiveness (C), Tensile Strength (TS), and Cook Yield (CY) of Precooked, Restructured Beef with and without .5 and 1.0% Gelatin (G) and 5 and 10% Raw (CT) and Preheated (PHCT) Connective Tissue[a]

Treatment	H (KGF)	C	TS (g/cm^2)	CY (%)
Control	23.14[ab]	34.48[c]	515.53[a]	90.0[bc]
.5 G	21.77[a]	26.34[ab]	615.56[ab]	89.3[b]
1.0 G	22.33[ab]	23.50[a]	698.28[bc]	88.1[a]
5 CT	24.75[ab]	31.02[bc]	689.97[bc]	90.7[cd]
10 CT	31.22[c]	34.56[c]	806.53[c]	90.9[d]
5 PHCT	23.14[ab]	27.55[ab]	656.14[a]	90.1[bcd]
10 PHCT	26.02[b]	29.26[b]	810.56[c]	90.0[bc]

[abcd]Columns only ($P < .05$).

Table 3. Sensory Assessment of Low-fat, Precooked, Restructured Beef with and without .5 and and 1.0% Gelatin (G) and 5 and 10% Raw (CT) and Preheated (PHCT) Connective Tissue

Treatment	Tensile strength	Firmness	Initial cohesiveness	Cohesiveness of mass	Juiciness	Beefiness
Control	4.13[a]	4.04[a]	6.96[b]	7.48[c]	7.28[c]	7.00[a]
.5 G	4.17[a]	3.85[a]	6.13[ab]	6.96[abc]	6.54[bc]	6.31[a]
1.0 G	4.72[a]	4.63[a]	5.57[ab]	6.09[abc]	5.26[ab]	5.41[a]
5 CT	4.31[a]	3.74[a]	6.04[ab]	7.22[bc]	6.54[bc]	6.56[a]
10 CT	5.67[a]	5.15[a]	4.87[a]	5.61[a]	4.81[a]	5.26[a]
5 PHCT	4.37[a]	3.93[a]	5.59[ab]	6.28[abc]	5.69[ab]	5.69[a]
10 PHCT	4.61[a]	4.17[a]	5.05[a]	6.07[ab]	4.70[a]	5.17[a]

[abc]Columns only ($P < .05$).